

WHAT IS CLAIMED IS:

1. A method of forming a conductive pattern such as an electrode on a compound semiconductor layer comprising the
5 steps of:

forming a first organic layer on the compound semiconductor layer;

forming a second layer on the first organic layer, the second layer being resistant to plasma ashing;

10 forming a pattern including a first aperture in the second layer;

forming a second aperture in the first organic layer by plasma ashing of the first organic layer using a mask pattern including the first aperture to expose the compound
15 semiconductor layer in the second aperture;

depositing a conductive layer over a region including the compound semiconductor layer exposed in the second aperture and the second layer; and

forming the conductive pattern on the compound
20 semiconductor layer by a lift-off process.

2. The method as claimed in claim 1, wherein the plasma ashing comprises an oxygen radical.

25 3. The method as claimed in 1, wherein the first organic layer comprises a photoresist layer.

4. The method as claimed in claim 3, wherein the method further comprises a step of baking the first organic layer at a predetermined temperature.

5 5. The method as claimed in claim 1, wherein the second layer comprises a photoresist having silicon which is resistant to the oxygen radical.

6. The method as claimed in claim 1, wherein the second
10 layer comprises an inorganic film.

7. The method as claimed in claim 1, wherein the second aperture of the first organic layer is processed by the plasma ashing to form an undercut to the first aperture of the second
15 layer.

8. The method as claimed in claim 1, wherein the compound semiconductor layer comprises a compound semiconductor substrate.
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9. The method as claimed in claim 1, wherein the compound semiconductor layer comprises gallium arsenide (GaAs).

25 10. A method of forming a conductive pattern over a compound semiconductor layer, the method comprising the steps of:

forming a first organic layer on the compound semiconductor layer;

forming an inorganic layer on the first organic layer;

forming a second organic layer on the inorganic layer;

5 forming a first pattern including a first aperture in the second organic layer;

forming a second pattern including a second aperture in the inorganic layer by etching the inorganic layer using a mask of the first pattern including the first aperture;

10 forming a third aperture in the first organic layer by plasma ashing of the first organic layer using a mask of the second pattern including the second aperture to expose the compound semiconductor layer in the third aperture;

depositing a conductive film over a region including the compound semiconductor layer exposed in the third aperture and the second organic layer; and

forming the conductive pattern on the compound semiconductor layer by a lift-off process.

20 11. The method as claimed in claim 10, wherein the first and second organic layers comprise photoresists respectively.

12. The method as claimed in claim 10, wherein the inorganic layer comprises indium-tin-oxide (ITO) or silicon
25 oxide (SiO).

13. The method as claimed in claim 10, wherein the

plasma ashing comprises an oxygen radical.

14. The method as claimed in claim 10, wherein the third
aperture of the first organic layer is formed in a shape of
5 an undercut to the second aperture of the inorganic layer.

15. A method of manufacturing a surface emitting
semiconductor laser, the surface emitting semiconductor laser
including a first semiconductor mirror layer of first
10 conductivity type over a substrate, a current confining layer
over the first semiconductor mirror layer, an active region
over the first semiconductor mirror layer, a second
semiconductor mirror layer of second conductivity type over
the active region and a contact layer including a compound
15 semiconductor layer over the second semiconductor mirror layer,
the method comprising the steps of:

forming a first organic layer on the contact layer;

forming a second layer on the first organic layer, the
second layer being resistant to a plasma ashing;

20 forming a pattern including a first aperture in the
second layer;

forming a second aperture in the first organic layer by
the plasma ashing of the first organic layer using a mask of
the pattern including the first aperture to expose the contact
25 layer in the second aperture;

depositing a conductive layer over a region including
the contact layer exposed in the second aperture and the second

layer; and

forming a conductive pattern on the contact layer by a lift-off process.

5 16. The method as claimed in claim 15, wherein a mesa structure which is extended from at least the contact layer to the current confining layer is formed, and wherein a part of region of the current confining layer is selectively oxidized from a sidewall of the mesa structure.

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 17. The method as claimed in claim 15, wherein the conductive pattern is an electrode which is connected with the contact layer in ohmic.

15 18. The method as claimed in claim 15, wherein the conductive pattern is formed in a ring shape and wherein an inner diameter defines an emission window for the laser light.

 19. A surface emitting semiconductor laser
20 comprising:

 a substrate;

 a first mirror formed over the substrate, the first mirror including semiconductor layers of first conductivity type;

25 a second mirror formed over the substrate, the second mirror including semiconductor layers of a second conductivity type;

a active region disposed between the first and second mirrors;

a current confining layer disposed between the first and second mirrors;

5 a compound semiconductor layer formed over the second mirror; and

an electrode formed on the compound semiconductor layer, wherein the electrode formed by a lift-off process utilizes an opening- pattern which is formed by a plasma ashing.

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20. A surface emitting semiconductor laser comprising:

a substrate;

15 a first mirror formed over the substrate, the first mirror including semiconductor layers of first conductivity type;

a second mirror formed over the substrate, the second mirror including semiconductor layers of a second conductivity type;

20 an active region disposed between the first and second mirrors;

a current confining layer disposed between the first and second mirrors;

25 a compound semiconductor layer formed over the second mirror; and

an electrode formed on the compound semiconductor layer, wherein a surface roughness of the compound

semiconductor layer in at least a peripheral portion of the electrode is not more than 5nm.

21 The surface emitting semiconductor laser as
5 claimed in claim 20, wherein the compound semiconductor layer includes a GaAs layer of the second conductivity type.

22. The surface emitting semiconductor laser as
 claimed in claim 21, wherein the surface roughness of the GaAs
10 layer is not more than 5nm.

23. The surface emitting semiconductor laser as
 claimed in claim 20, wherein the electrode is formed in a
 ring-shaped pattern on the contact layer and wherein an inner
15 diameter of the ring-shaped pattern defines an emission window
 for the laser light.